Commentary

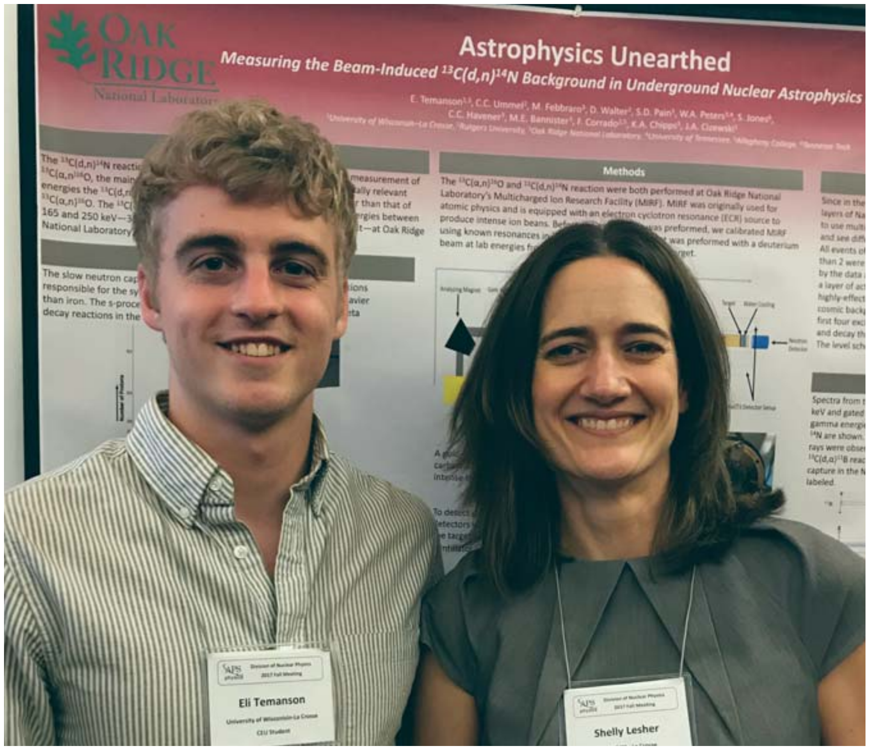
Introducing undergraduates to the conference experience

For the past 20 years, enthusiastic undergraduate students in the Conference Experience for Undergraduates (CEU) program have been an indispensable part of the American Physical Society (APS) division of nuclear physics (DNP) annual fall meeting. The 2017 gathering in Pittsburgh, Pennsylvania, in late October was a special 20th-anniversary celebration of the CEU, with opportunities for students to have important interactions with fellow students and future advisers.

David Gross opened the meeting; he, Frank Wilczek, and David Politzer received the 2004 Nobel Prize in Physics for their discovery of asymptotic freedom in quantum chromodynamics.

Other invited speakers included former CEU students who discussed their undergraduate experiences, career trajectories, and the program's effects on their future careers. Attendees heard from CEU alumnus Michael Miller, who after earning a PhD in experimental particle physics followed the nontraditional path of founding an early cloud-computing startup company and then a venture capital firm. Michael Keim, an attendee from Washington University in St Louis, noted that Miller's presentation showed him "wonderful opportunities outside academia." Other CEU alumni in the session included Christine Aidala, an associate professor at the University of Michigan, and Calem Hoffman, a staff scientist at Argonne National Laboratory.

Each year, in addition to presenting posters, the CEU students participate in a special program designed to enhance their conference experience. Students room together and have an opportunity to experience being part of the community and finding a place for themselves in the field. They meet DNP leaders and attend lectures specifically for them. Two lectures are on the hot scientific topics of the day, and a third is designed to help students maneuver through the graduate school application process.



SHELLY LESHER (right), author of this commentary, with undergraduate research student Eli Temanson during the Conference Experience for Undergraduates poster session in Pittsburgh, Pennsylvania.

Also included in the CEU lineup is a graduate school recruitment session; in 2017, 20 graduate schools participated. All CEU sessions allow senior scientists, graduate students, postdoctoral fellows, and undergraduates to talk freely and ask questions. Keim, who presented a poster titled "A nonlocal application of the dispersive optical model to ^{208}Pb," said, "I met a professor from Ohio University who introduced me to other methods of modeling nonlocality (dispersive) optical models, met an undergraduate who used a different basis that increased computational speeds, and learned how researchers gather the experimental data I use in my model."

The CEU program was founded in 1998 by Warren Rogers while he was at Westmont College in California. The nuclear-physics community has a long-standing tradition of engaging students in research projects—primarily at undergraduate institutions, research universities, and national labs. With funding Rogers obtained from NSF and the Department of Energy through the national laboratories, the CEU program has been a tremendous success and one of the liveliest parts of the annual DNP meeting. The poster session for undergraduate presentations is highly anticipated by most attendees because of its energy and spirit.

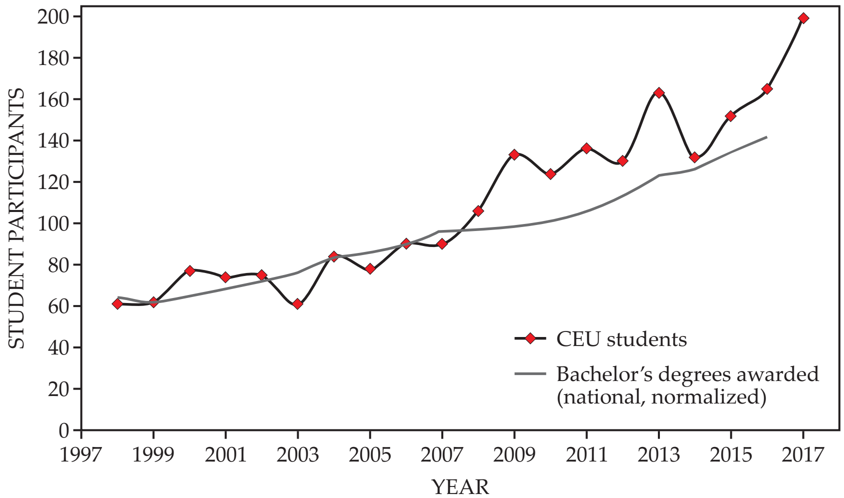
Applying to the program has two steps: Students submit their research abstracts to the APS conference website, and they submit an application and a statement of their project contribution to the CEU website. Those materials are forwarded to a review committee that judges the contributions and makes recommendations to the CEU director, who makes the final registration, travel, and housing decisions. Attendance for most of the qualified students is at least partially funded.

In the 20 years since the CEU was founded, approximately 1800 students have presented 2200 posters. This year 199 students took part, the largest group in the program's history. The figure on page 12 traces the program's growth. An early analysis of 286 participants in 1998–2002 found that 74% of CEU students pursued advanced degrees, 49% of which were PhDs in physics. And among those CEU students, 23% earned PhDs in nuclear physics. According to data from the American Institute of Physics (which publishes PHYSICS TODAY), for that same time period, 50% of all physics graduates pursued advanced degrees and only 29% were enrolled in PhD programs in physics or astronomy. A detailed analysis on career trajectories is under way, but exit surveys consistently indicate that CEU graduates are interested in pursuing graduate studies in physics and nuclear science. As Argonne's Hoffman said, "The CEU program's continued impact on all subfields and flavors of nuclear science is simply undeniable."

Between 2001 and 2017, the number of CEU students increased from 69 to 199, and the percentage of women in the program increased from 19% to 29%. In addition, the percentage of CEU students involved in research at their home institutions rose from 22% in 2001 to 58% in 2017. The majority of that research is conducted at top research universities. The national laboratories play an important role in training undergraduate physics students, directly through summer fellowships and indirectly with instrumentation or experimental support.

The CEU program is unique. No other scientific society has such a large, funded, and dedicated undergraduate program. The experience of participating in a national professional conference helps all students, especially those from small universities. They meet other physics students and are "amazed by how connected we all are," according to E-Lexus Thornton, a senior at Indiana University South Bend.

I was accepted into the first class of CEU students in 1998; my poster was titled "Observation of new $K = 0^+$ bands in ^{158}Gd." I was surprised that other scientists found my work interesting and important. I was simultaneously terrified and excited to have famous physicists stop by my poster and discuss my results.



NUMBER OF STUDENTS who have participated in the CEU program so far. The number of bachelor's degrees awarded in physics for years 1998–2016 is also included after normalization to 2006 data. (National data are adapted from refs. 1 and 2.)

That exposure, along with the overall conference experience, solidified my resolve to attend graduate school in nuclear physics. At that DNP meeting, I met both my future graduate adviser, Steve Yates, and my postdoctoral adviser, Con Beausang, and I forged professional and personal relationships that continue today.

Over the past seven years, I have been able to send nine of my undergraduate students to the DNP gathering. Among them were the first student I mentored at the University of Wisconsin–La Crosse, Patrick Copp, now attending graduate school in nuclear physics at the University of Massachusetts Lowell, and Eli Temanson, currently applying to graduate school. It is exciting to see the program come full circle.

In 2016 I became the director of the CEU. The 20th-anniversary CEU last year was my second as director. With great anticipation, I look forward to the next generation of undergraduates, the future of the field.

References

1. P. J. Mulvey, S. Nicholson, *Physics Bachelor's Degrees: Results from the 2014 Survey of Enrollments and Degrees*, American Institute of Physics Statistical Research Center (November 2015).
2. S. Nicholson, P. J. Mulvey, *Roster of Physics Departments with Enrollment and Degree Data, 2016: Results from the 2016 Survey of Enrollments and Degrees*, American Institute of Physics Statistical Research Center (December 2017).

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LETTERS

The birth of modern planetary science

I can't blame a planetary scientist for thinking, as Brett Denevi espouses in "The new Moon" (PHYSICS TODAY, June 2017, page 38), that modern planetary science began when we went to the Moon. Actually, it was alive and well for quite a few years before that. A better birth date might be 1942, when Austrian refugee Friedrich Paneth, working with two colleagues, discovered an excess of helium-4 in several iron meteorites, which indicated that the universe was older than was currently accepted.[1]

World War II shut down such research, but by 1948 the excess helium was postulated to have originated from nuclear reactions induced by cosmic radiation.[2] Fred Singer calculated, and Paneth verified,[3] the relative cosmogenic production rate of ^{3}He. Their work encouraged the use of meteorites as space probes well before rockets were available.

Further research followed. Fritz Houtermans established the Institute of Physics at the University of Bern, and Claire Patterson at Caltech used lead isotopes to narrow the age of Earth to four and a half billion years.[4] In 1960 John Reynolds found evidence of the extinct radionuclide iodine-129 in the isotopic composition of xenon in the Richardton meteorite,[5] and further isotopic analyses of meteorites brought forth a plethora of data, which soon extended to many other elements. (The xenon spectrum alone provided jobs and funding to a whole generation of graduate students.)

In the mid 1960s, a group of planetary scientists led by John Wasson at UCLA took over an amateur group called the Meteoritical Society and transformed it into a vibrant source of international meetings and cooperation, augmented by yearly Gordon Research Conferences and various European meetings sponsored by the International Atomic Energy Agency. Before the first Moon landing in 1969, cosmochemistry laboratories were active in Japan, the USSR, Australia, France, the UK, Switzerland, and Germany. In the US, there were such labs at several universities—UC Berkeley, UC San Diego, Chicago, Minnesota, Arkansas, Missouri, Carnegie Mellon, and Cornell—and at Brookhaven National Laboratory and the Harvard–Smithsonian Center for Astrophysics.

When we finally went to the Moon, we were indeed enthusiastically expectant, largely because of Nobel laureate Harold Urey's suggestion that lunar data would be the Rosetta stone of the solar system, unlocking the mysteries of its birth and development.

Well, Urey's suggestion may come true someday. But right now it seems that human exploration of the Moon is perhaps a large blip in the history of planetary science rather than its originating moment.

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